

# RNG MODEL LEARNINGS & EVOLUTION OF RENEWABLE TRANSPORTATION FUEL

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# INTRODUCTION

## 1. My Background

- Energy Industry
  - Credit/Risk Management
  - Trading/Asset Management
  - Compressed Natural Gas (CNG) Market
  - Renewable Credit Markets

## 2. PFB RNG Projects

- Pagel's Ponderosa – 5,500 milk cows
- Dairy Dreams – 3,000 milk cows
- Virtual Pipeline projects retrofitted from legacy digesters producing power
- Operating since mid-2019



# OUTLINE

## RNG Model Learnings

1. What is RNG and how is it made
2. RNG Pathways
  - Physical Pathway
  - Contractual Pathway
3. RNG Credit Markets
  - California Market
  - US Market
4. Where the money is made
  - Physical gas
  - RIN (Federal) credit
  - LCFS (State) credit

## Evolution of Renewable Fuel

1. EV cannibalization of CNG
  - Transit
  - Refuse
2. Changing of the Guard
  - Renewable Diesel (soybeans)
  - Ethanol (corn)
  - Hydrogen?
3. What does it all mean?
  - Future of RNG
  - LCFS/RIN Credit Prices
  - Biofuel crops



# WHAT IS RNG & HOW IS IT MADE

- What is Renewable Natural Gas (RNG)
  - RNG is biomethane produced from a renewable source and sold as transportation fuel (CNG)
    - Landfills
    - Anaerobic Digesters (AD)
      - Manure
      - Food Waste
      - Wastewater Treatment Plants
- How is RNG made
  - Landfill or AD project produces Biogas (~50% CO<sub>2</sub> + ~50% methane)
  - Gas cleanup facility scrubs out impurities to produce biomethane
  - Compressed Natural Gas (CNG) fueling station compresses biomethane and dispenses it as vehicle fuel (RNG)



# RNG PATHWAYS

## Current Value Chain (RNG to CNG)

1. Physical Pathway
  - Gas Interconnect
  - Interstate Pipeline
  - CNG Fueling Station
  - Credit Generation
2. Contractual Pathway
  - Producer (Digester Project)
  - Gas Marketer
  - CNG Off-Taker
  - Credit Broker

## Future Value Chain (RNG to EV)

1. Physical Pathway
  - Gas Interconnect
  - Interstate Pipeline
  - ***Nat Gas Power Plant***
  - ***EV Charging Station***
  - Credit Generation
2. Contractual Pathway
  - Producer (Digester Project)
  - Gas Marketer
  - ***Utility or EV Charging Station***
  - Credit Broker



# RNG CREDIT MARKETS

- California Low Carbon Fuel Standard (LCFS) Market
  - RNG ~10% of overall market
  - CNG demand approximately 165M gallons in 2020 but down 10% from 2019
    - 98% of CA CNG capacity receiving RNG
  - 1 milk cow = approximately 150 gallons of fuel per year
  - 10-15% of US milk cow herd
  - Market potential ~250 RNG Projects @ average project size of 5,000 cows
- Federal Renewable Fuel Standard (RFS) Market
  - Expect strong support from President Biden (for D3 at least)
  - D3 RINs are ~2% of overall market (500M out of 20B gallons of biofuel)
  - RNG value much lower if sold outside California



# WHERE THE MONEY IS MADE

- 1 milk cow = approximately 20 MMBtu per year
  - Physical (brown) gas =  $\$5/\text{MMBtu} * 20 = \$100$
  - RIN (federal) credit =  $\$2.50/\text{RIN} = \$29/\text{MMBtu} * 20 = \$580$
  - LCFS (California) credit =  $4 \text{ MT}/\text{cow} * \$170/\text{MT} = \$680$
  - Total RNG value/cow/year =  $\$1360$
- That does not mean farmer gets \$1360/cow!
  - Every step in the value chain (contractual pathway) takes a cut
    - Producer > Gas Marketer > CNG Fueling Station > RNG Credit Broker
  - Farmer share will depend on level of project participation
  - Project owner (Producer) will get lions share



# EV CANNIBALIZATION OF CNG

- CNG Market Penetration
  - Light Duty Passenger Vehicles – none
  - Transit – significant
  - Refuse – significant
  - Heavy Duty OTR (Semi-Trucks) – limited due to payload constraints
- EV structural advantages to CNG
  - Fuel more readily available
  - Easier to handle (no fuel quality issues)
  - Lower O&M expense – both from fueling station and vehicle perspective
  - Cost per mile (fuel economy)





# EV CANNIBALIZATION OF CNG

- [L.A. Metro deploys first 60-foot zero-emission electric bus for revenue service on the G Line | Mass Transit \(masstransitmag.com\)](#)
- [Commercial EV company Arrival to build electric buses for Anaheim | TechCrunch](#)
- [NYC Beer Distributor Spikes CNG Fleet With Electric Trucks \(cleantechnica.com\)](#)
- [LA Sanitation Commits to 100% Electric Refuse Truck Fleet \(waste360.com\)](#)
- [NFI, Schneider deploy 100 electric trucks in CA, ACT Expo 2021](#)



# CHANGING OF THE GUARD

- Ethanol
  - Rapid growth in 2000s to 15B gallon market today
  - Demand will be negatively affected by declining gasoline market
  - Highest average CI score compared to other renewable fuels
- Renewable Diesel
  - Different than biodiesel which can only be blended up to 20%
  - Chemical composition identical to crude-derived diesel
  - 100% drop-in replacement
  - Refineries being retrofitted to process renewable feedstocks vs crude oil
  - Production capacity expected to grow from 1B gallons to 5B by 2025
    - Enough to supply 100% of CA diesel market

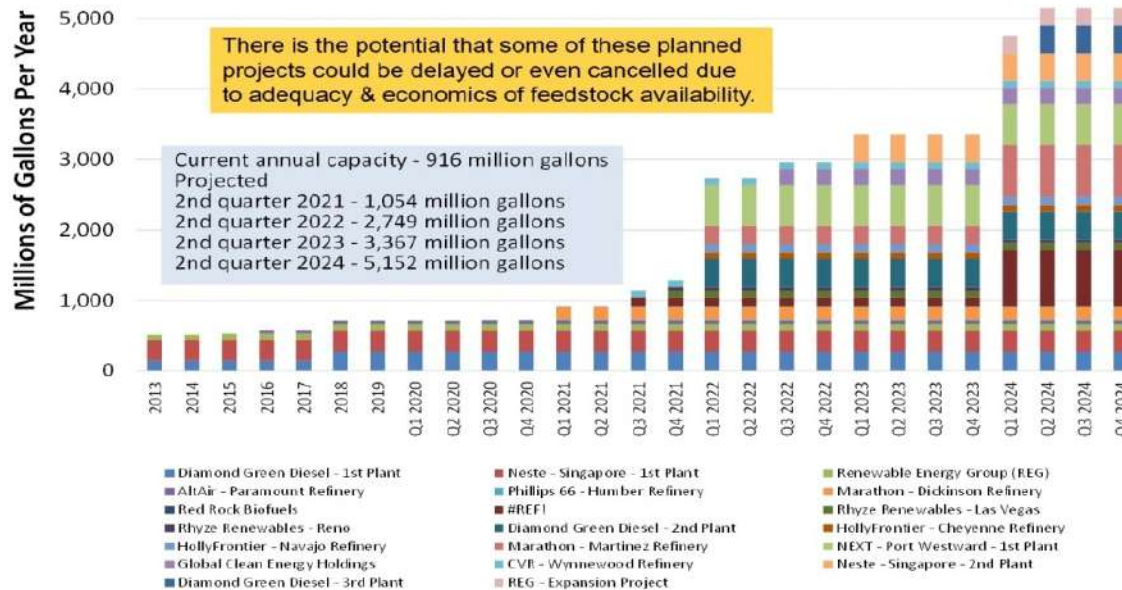


# RAPID RENEWABLE DIESEL GROWTH



## Increasing Renewable Diesel Availability

Source: California Energy Commission analysis of multiple reports and announcements.

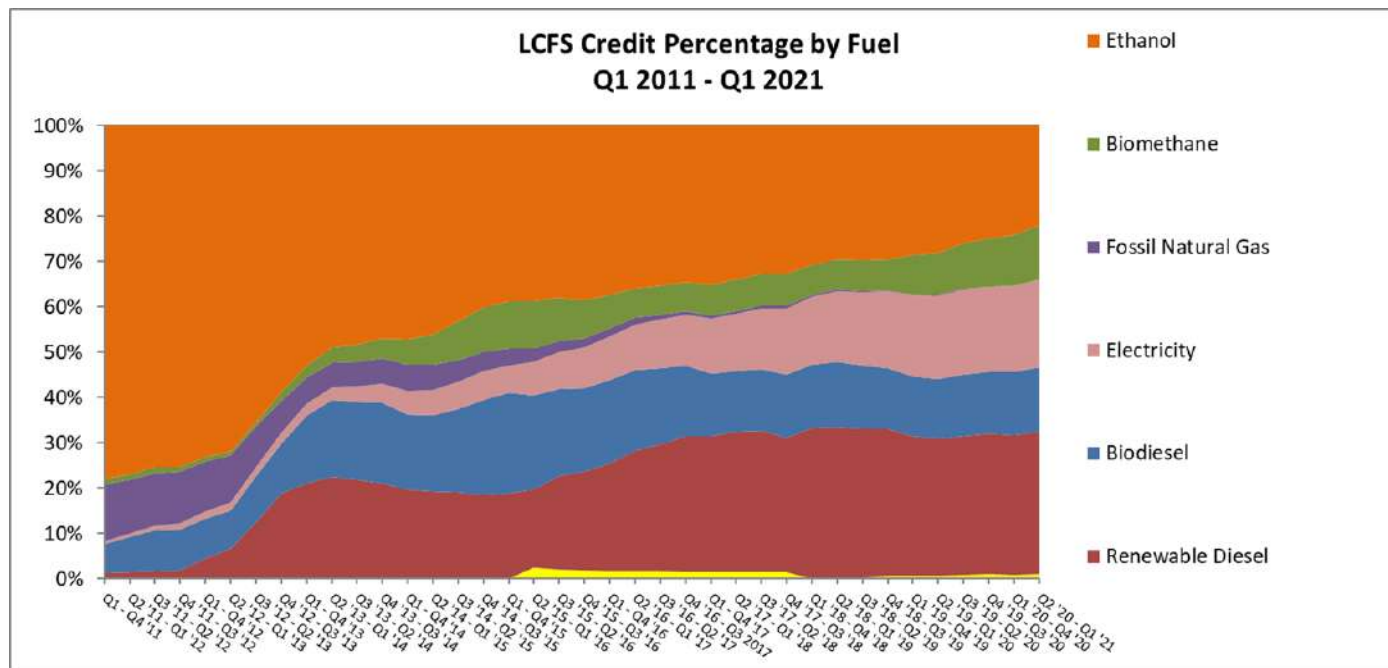


# WHY CAN'T WE BE FRIENDS

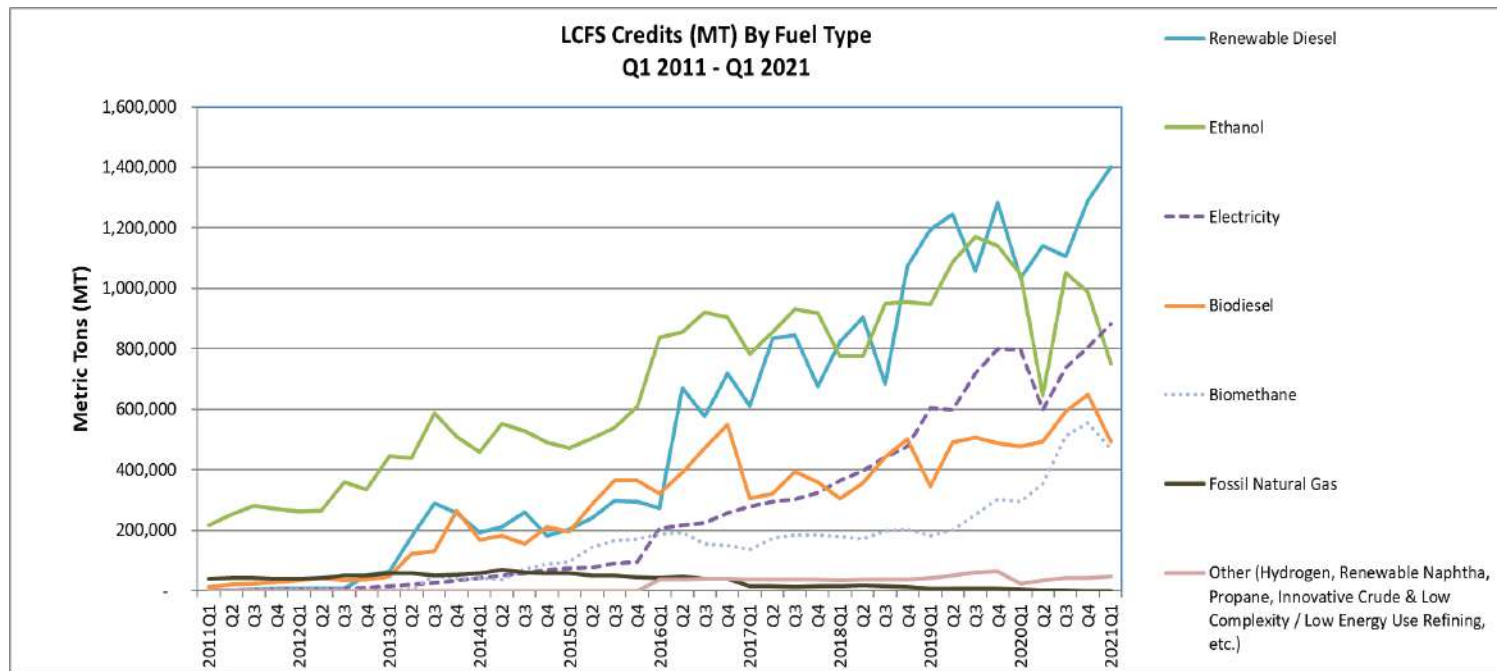
- BigAg and BigOil, fierce opponents on ethanol, now forming partnerships on renewable diesel
  - ADM & Marathon Petroleum
    - <https://www.adm.com/news/news-releases/marathon-petroleum-corp-adm-announce-feedstock-partnership-to-support-renewable-diesel-production>
  - Bunge & Chevron
    - <https://www.bunge.com/news/chevron-bunge-announce-proposed-joint-venture-create-renewable-fuel-feedstocks>
- RD feedstock will be limiting factor to growth trajectory
  - 1 acre corn = 490 gallons ethanol
  - 1 acre soybeans = 70 gallons RD



# EVOLUTION OF RENEWABLE TRANSPORTATION FUEL



# EVOLUTION OF RENEWABLE TRANSPORTATION FUEL



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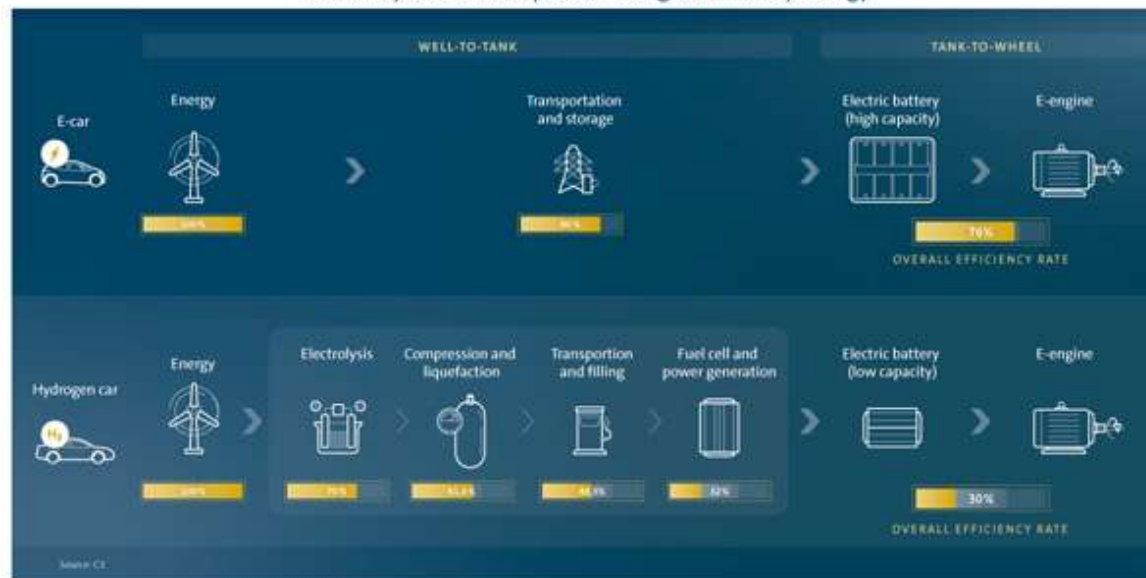
# WHAT ABOUT HYDROGEN?

- Lot of believers, but significant hurdles to overcome
  - Lack of existing infrastructure to piggyback off
  - Very inefficient processes to produce (stripping H off H<sub>2</sub>O or CH<sub>4</sub> consumes a lot of energy)
  - Very expensive to transport and store
  - Even proponents acknowledge drawbacks
    - Excerpt from Wall Street Journal article: Paul Bogers, Shell's vice president of hydrogen. "For green hydrogen, the core belief is that you almost have to get to a world where the electrons are free."
  - Value chain similarities to CNG which puts it at disadvantage vs EV or RD



# HYDROGEN VALUE CHAIN

## HYDROGEN AND ELECTRIC DRIVE Efficiency rates in comparison using eco-friendly energy





# WHAT DOES IT ALL MEAN?

- Future of RNG?
  - Anaerobic digesters are here to stay
    - Essential component to reducing carbon footprint and getting to net zero
  - RNG more likely to be used as a feedstock for EV than as a transportation fuel
- Future Credit Prices?
  - Market dynamics have bearish implications for LCFS prices in CA
  - 600M gallons of RD in CA is going to turn into 2B gallons very quickly
  - EV adoption is going to be faster than people are anticipating
  - 50%+ drop to under \$100/MT in 2 years very possible
  - Position your participation in RNG project to insulate your dairy from LCFS risk
    - Fixed royalty or compensated on a \$/head or \$/gallon of manure basis
    - Reconsider putting capital at risk for greenfield project with COD post 2024



# WHAT DOES IT ALL MEAN?

- Future Transportation Fuel Mix?

- Gasoline to EV
  - EVs will displace legacy gasoline vehicles
- Diesel to Renewable Diesel
  - Heavy duty vehicles can achieve carbon reduction goals without any changes to their operation or capital investments
  - Avoid payload constraints that EV, RNG, and Hydrogen have
- Transition will take decades, not years



# WHAT DOES IT ALL MEAN?

- Future Acres Planted Mix?
  - More soybeans, **more canola**, less corn
  - Oil content will drive future biofuel crops
    - Soybeans (20% oil content @ 50 BPA): 70 gallons RD per acre
    - Canola (45% oil content @ 40 BPA): 125 gallons RD per acre



# QUESTIONS?

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